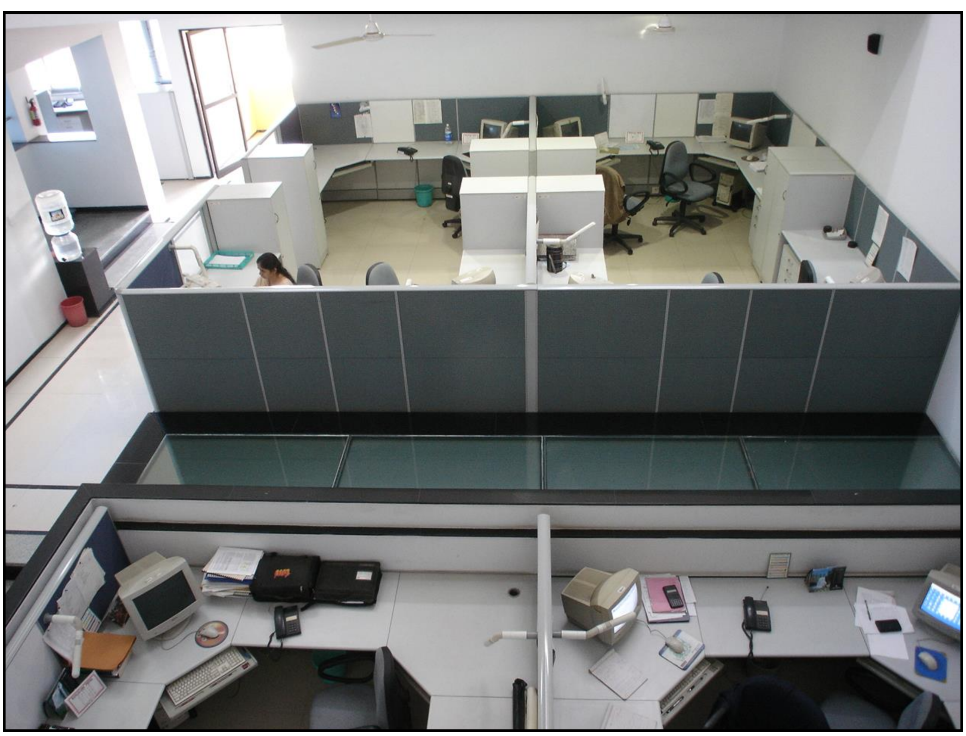
GRIHA
Green Rating for Integrated Habitat Assessment

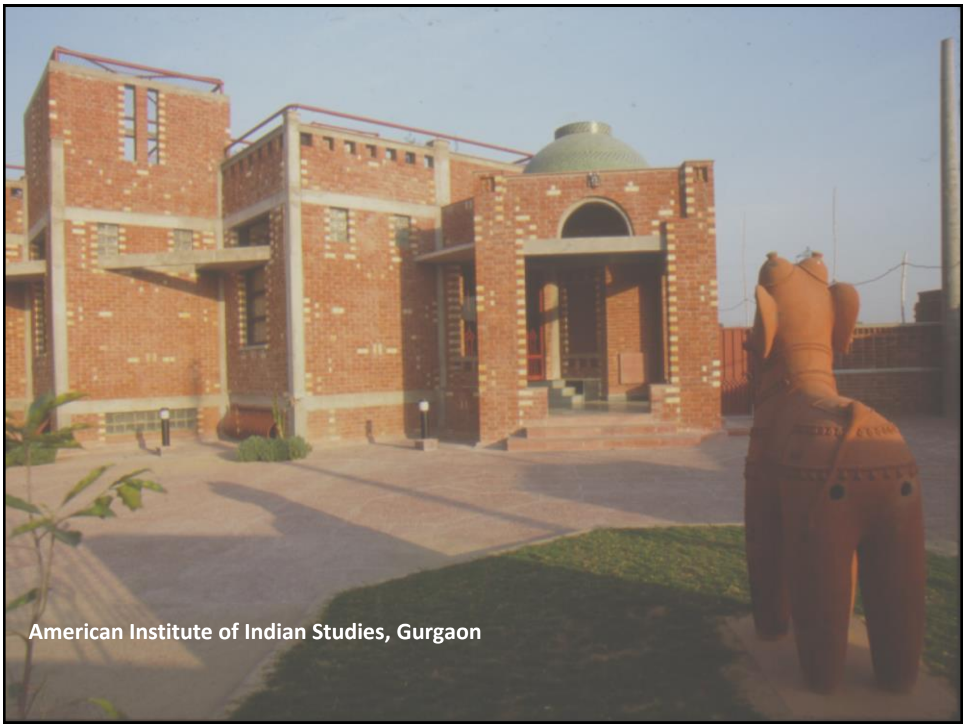
The Energy and Resources Institute

SUSTAINABLE FACADE CONFERENCE 2016

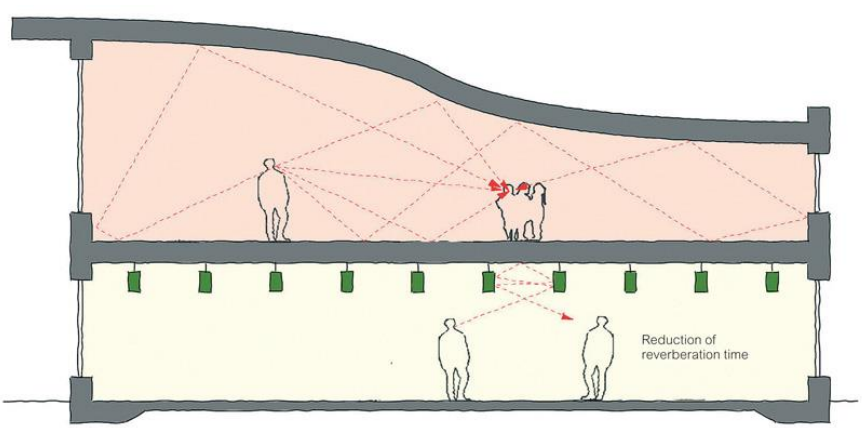
SPECIAL EVENT DURING 7TH GRIHA SUMMIT 2016

Functions of Sustainable Facade





Noise control

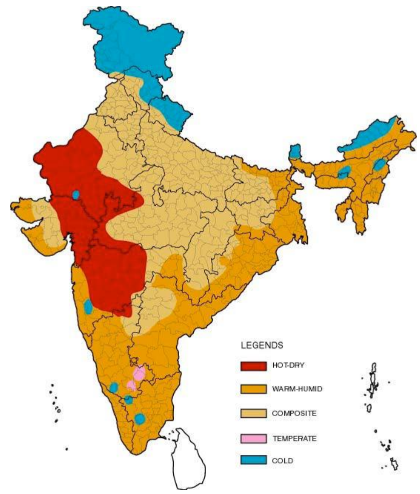


Resilient to Climate Hazards

Sustainable Architectural Facades

Architectural design that provides comfort to occupants using nature's resources and with minimal impact on the environment.

Green Building Initiatives for Climate Resilient Affordable Housing



Project for HUDCO

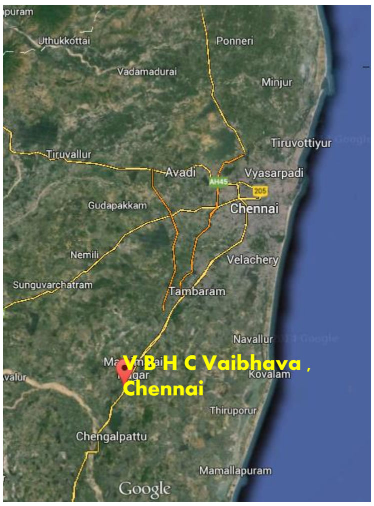
Good Earth Malahar, Bangalore

Façade needs to respond to local context, cultural values, tradition

Case Study

V B H C Vaibhava

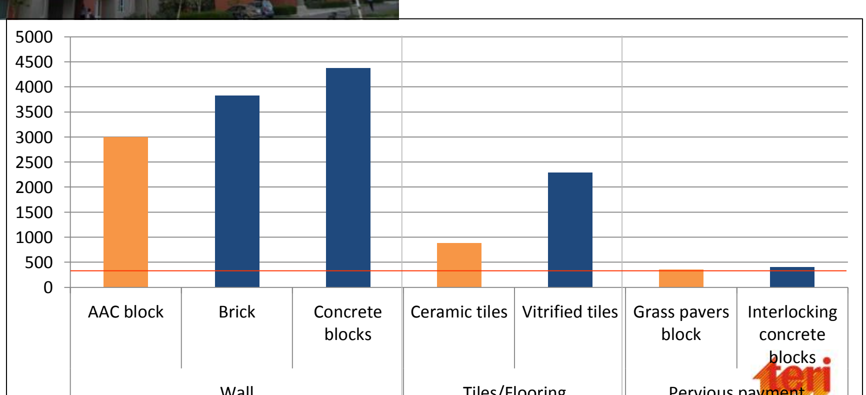
Architect: InFORM



Climate (as per NBC)	Warm- Humid
Architect	Inform
FSI	1.3
Density	180 families/Hectare
Construction Period	18 Months
Level of Mechanisation	High
Skilled Labour	High
Total Cost of Construction	~Rs. 2400/Sft
Distance From City	~50 KM

Aura – Mahindra Life spaces, Gurgaon

Respond to Urban Planning



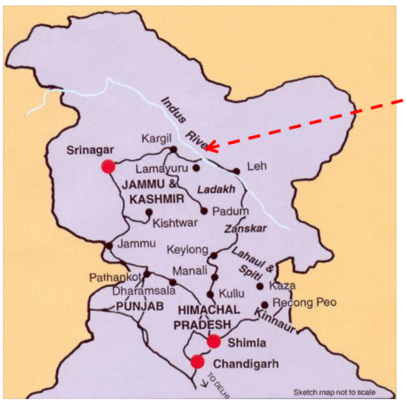
Case Study

Passive Solar houses - Ladakh

Location

Located to North of Leh

160 Km from Centre of City

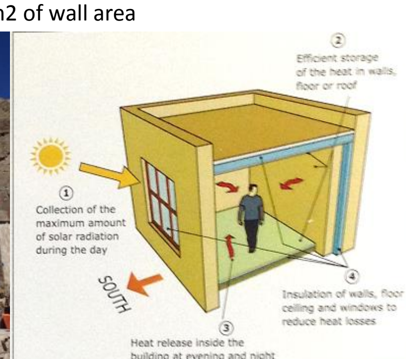


Ursi village

3 Types of PSH Design

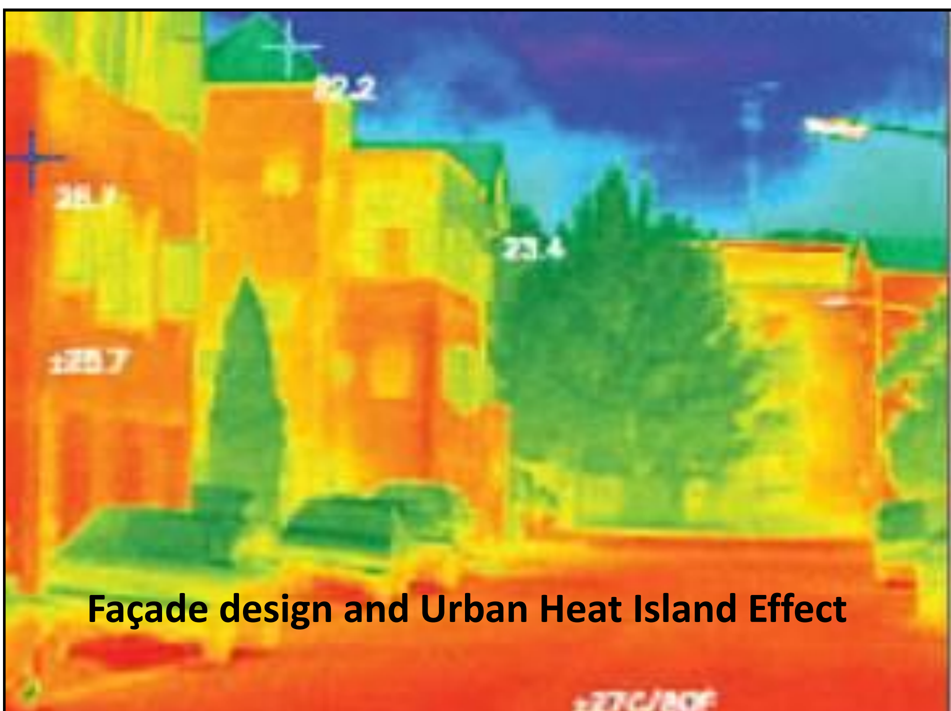
Direct gain (DG)

Construction cost = INR 958/m2 of wall area



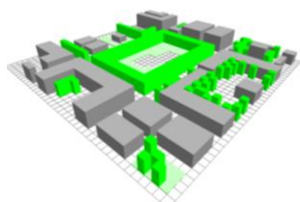
Solar Wall (SW)

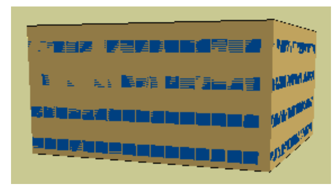
Construction cost = INR 1596/m2 of wall area

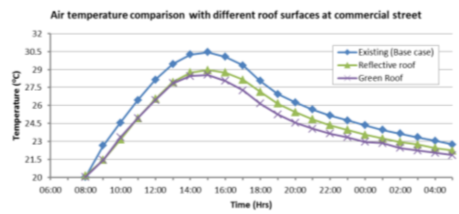


Façade design and Urban Heat Island Effect

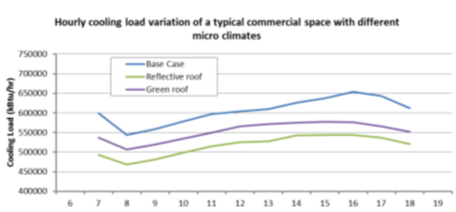
Sustainable Building facades: Minimizing urban heat island effect and imperviousness factor

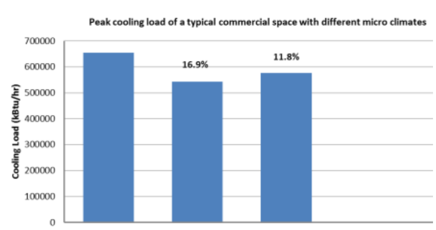






Cooling load reduction due to improved micro climate

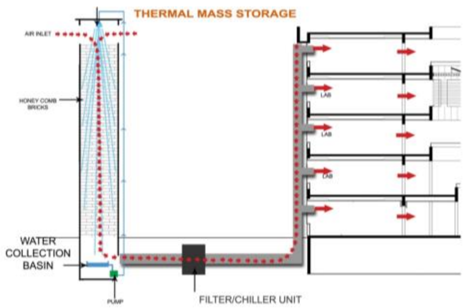




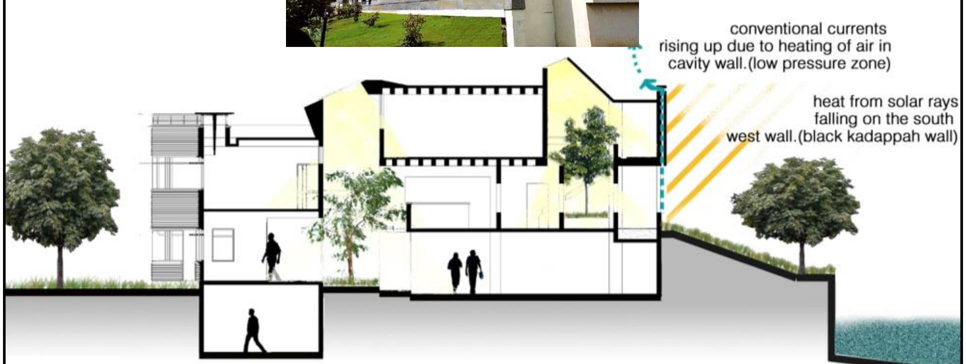
	Base Case	Reflective Roof	Green roof
Building Type	Commercial Office	Commercial Office	Commercial Office
Zone Area	40000Sft	40000Sft	40000Sft
Height	3 m	3 m	3 m
Lighting power density	1.4 W /ft^2	1.4 W /ft^2	1.4 W /ft^2
Equipment power density	0.75 W /ft^2	0.75 W /ft^2	0.75 W /ft^2
Occupants	275 ft^2 / person	275 ft^2 / person	275 ft^2 / person
Occupancy Schedule	8 hours, 5 days a week	8 hours, 5 days a week	8 hours, 5 days a week
External wall	Uninsulated 230mm Brick Wall	Uninsulated 230mm Brick Wall	Uninsulated 230mm Brick Wall
External Roof	Uninsulated 150mm RCC Roof	Uninsulated 150mm RCC Roof with reflective coat (albedo 0.9)	Green Roof with U- value 0.23W/m2
Glazing Specification	6mm clear glass	6mm clear glass	6mm clear glass

Façade to compliment Heating/cooling strategies

Low energy cooling- Thermal Storage system

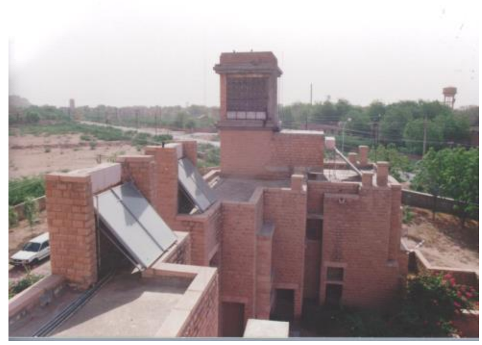


Natural Ventilation and cooling



Wind tower

- Daytime- outside air enters through the openings, gets cooled, becomes heavier ,sinks down and into the rooms and vented out through the windows
- Nighttime-the tower warms up, draws in cooling air through the windows and creates upward draught.



Solar chimney

- Uses stack effect, but chimney deliberately heated by solar radiation.
- Space detached from the main building.
- Advisable for regions with low wind speed.
- Could be roof or wall integrated.
- Could be coupled with other natural conditioning systems

Aesthetic Aspiration - Branding

Ashok Leyland Office (West Façade), Chennai

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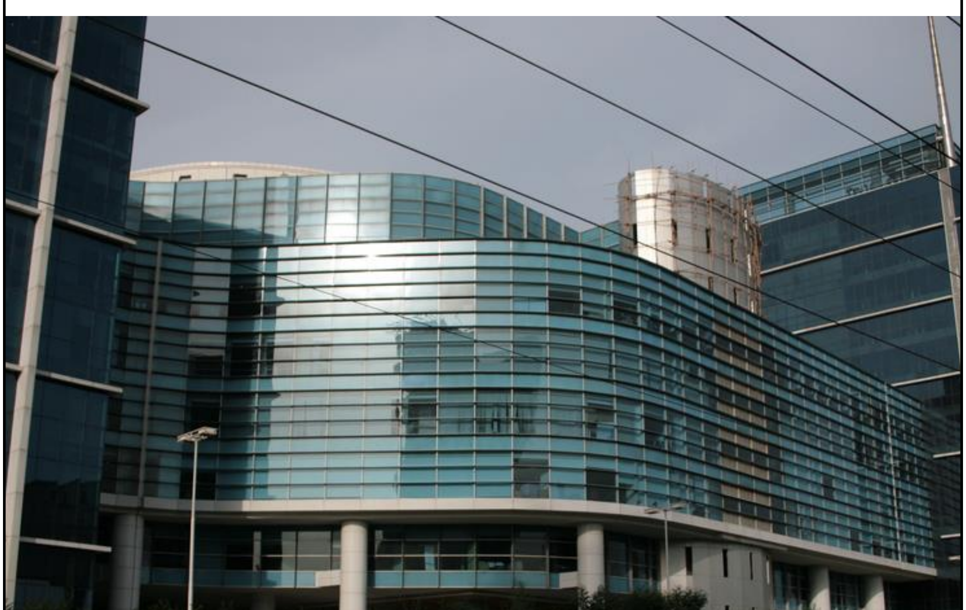

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Modern buildings

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Modern buildings


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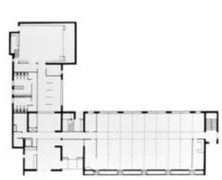
Modern buildings


Examples from Europe

Application of bioclimatic architectural principles and passive feature examples could be learnt both from National as well as International buildings.

Universally applicable principles of natural daylight and passive cooling/heating

BRE Office Building I Watford (UK). I Feilden Clegg Architects



- British Research Establishment office
- L-shaped building
- 2000 m2 total floor area
- North South facing
- Natural ventilation and daylight strategy through:-
- Stack towers
- Wave shaped ceiling slabs
- Automatic & manual control shading devices
- Natural daylight
- Exposed concrete ceiling for night ventilation
- Energy consumption of 144 kWh/sq m/annum

Queens Building, De Montford University I Leicester (UK). I Short Ford & Associates

Houses school of Engineering & Manufacture.

- Environmental aspects of design through natural ventilation and daylighting
- Double height Mechanical Lab
- Central deep 4 storied section for general labs.
- U shaped 4 storied narrow wings for electrical labs.
- Ventilation through ridge vents. Cool fresh air is introduced at low level. High illuminance achieved through roof lights.

Sainsbury Supermarket I London (UK). I Chetwood & Associates

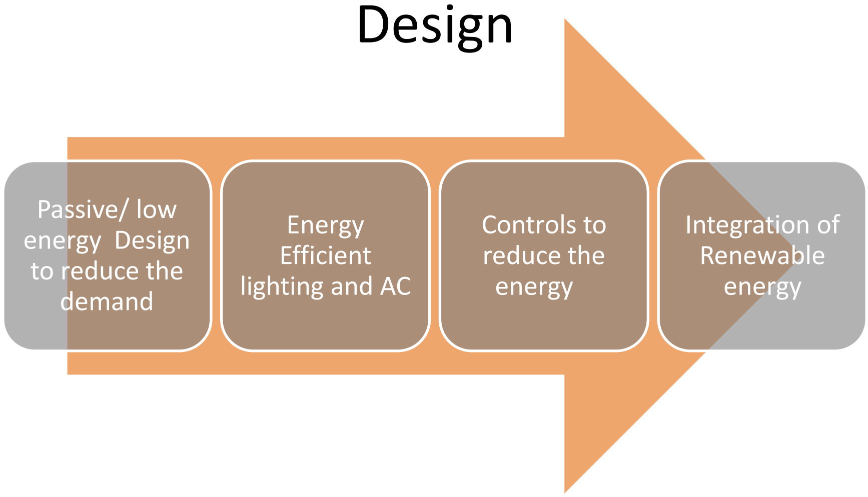
Sainsbury Super market located in Greenwich, London

- Sales floor background lighting turned off during the day, display lighting at product level.
- Double glazed north lights.
- Passive ventilation roof vent dampers.
- Light colored floor and ceiling to enhance internal reflectance.

Building Envelope

- Windows / Fenestration / Aperture
- Walls / Opaque surfaces
- Roof

Process to achieve Efficient Façade Design

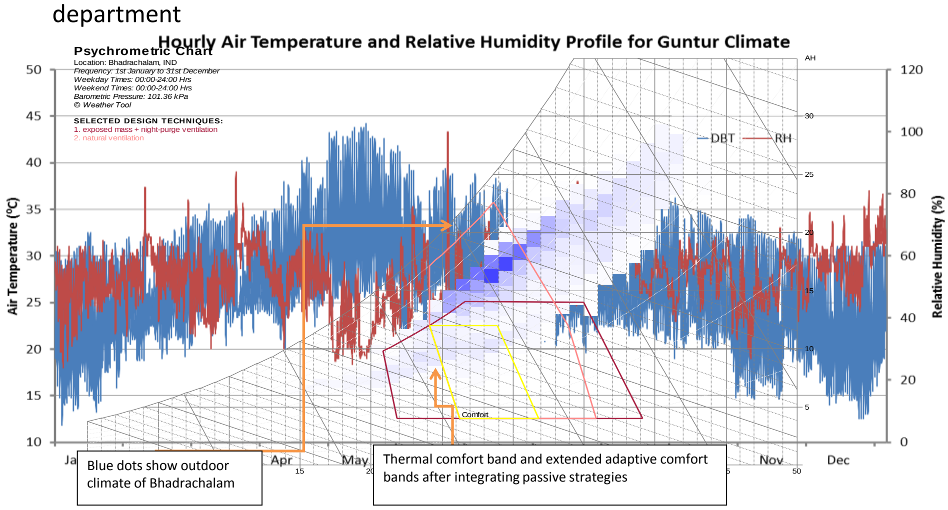


Orientation

- Daylight availability
- Sun path diagram, to keep away the sun and reduce external heat gains

Climate Analysis

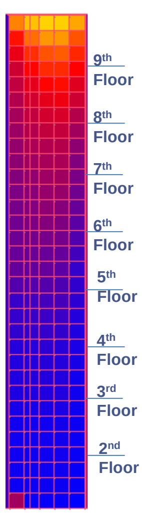
Hourly weather file processing from daily data acquired from meteorology department



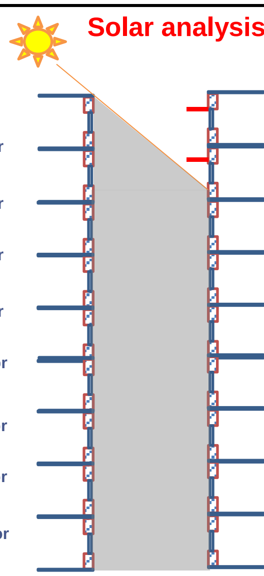
ITC Bhadrachalam – Residential Township

- Solar irradiation analysis – high rise dense development

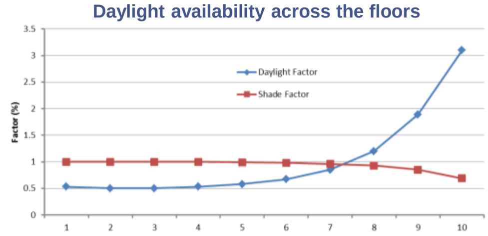
Solar analysis for High-rise structures

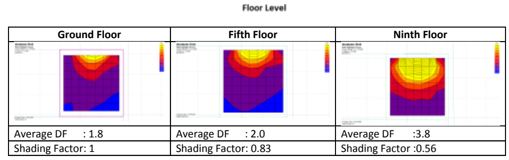


Solar Exposure



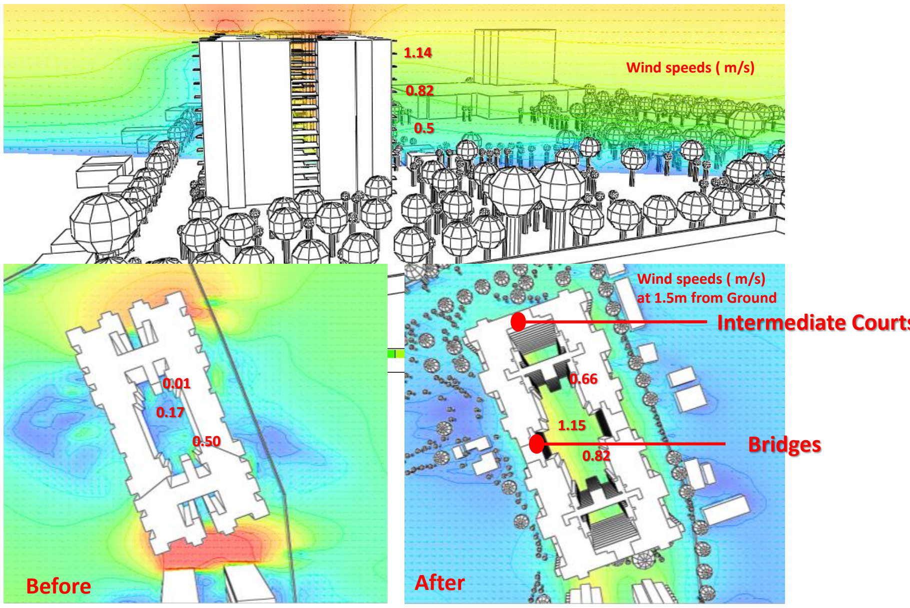
Schematic section showing shading design to respond to solar exposure





- Increase in daylight and decrease in shading factor especially in rooms facing inner courtyards - as we go up in dense developments
- No additional shading for lower floors and an optimized shading for upper floors is recommended to maintain uniform thermal and visual comfort conditions across the floors

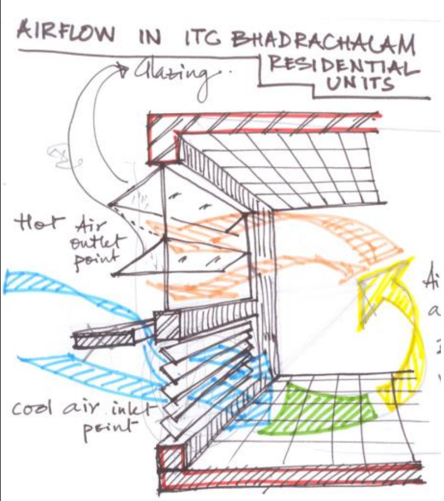
Out door Wind Flow analysis for High-rise structures



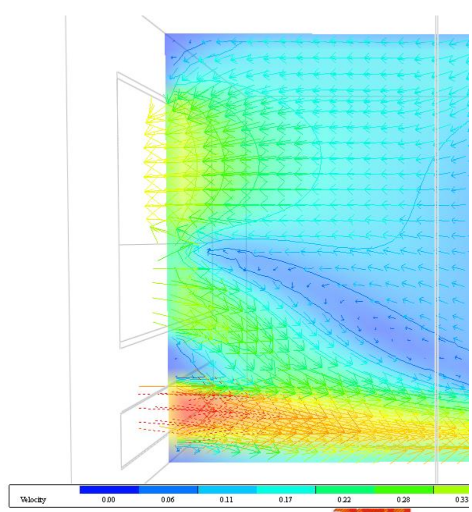
- Higher wind speeds for better comfort in outdoor ,semi outdoor and courtyard spaces and by adding a stilt, bridges and intermediate courts and landscape elements

Conceptual Sketch and actual CFD model of Window System Proposed For Non Ventilated Spaces

Conceptual sketch



CFD Model

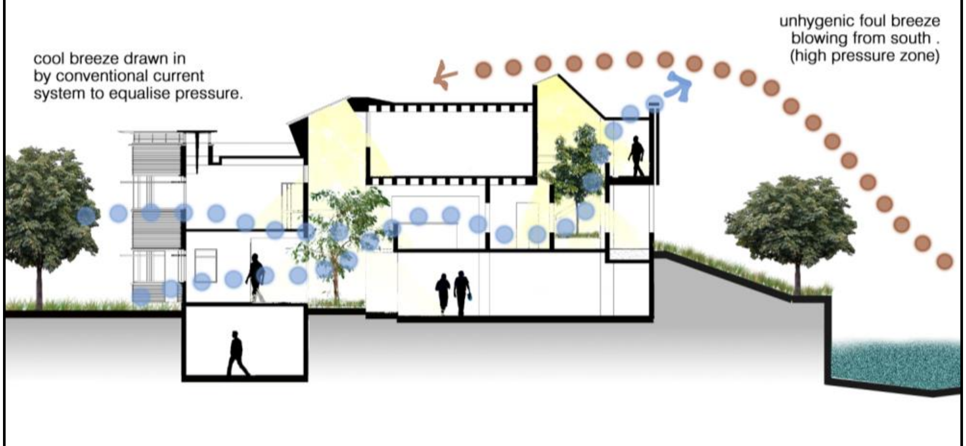


Building envelope optimization for Air conditioned and Non Air conditioned spaces

		Roof	Wall	Glazing_View Window			AC Spaces
	Alternative	U-Value	U-Value	U-Value	SHGC	VLT	Reduction in TR Load
		W/m2K	W/m2K	W/m2K			(%)
1	Base Case	2.49	3.17	6.17	0.815	0.88	
2	ECBC Roof Case_Over deck	0.36	3.17	6.17	0.815	0.88	1.76
3	ECBC Roof Case_Under deck	0.37	3.17	6.17	0.815	0.88	-0.18
4	Glazing optimised Case	2.49	3.17	1.59	0.28	0.4	4.20
5	Cumilative 1(Over Deck)	0.36	3.17	1.59	0.28	0.4	9.67
6	Cumilative2 (Under Deck)	0.37	3.17	1.59	0.28	0.4	7.93

Daylight harvesting: BSBE Building, Kanpur

Daylight



Renewable Energy Integration in Site planning

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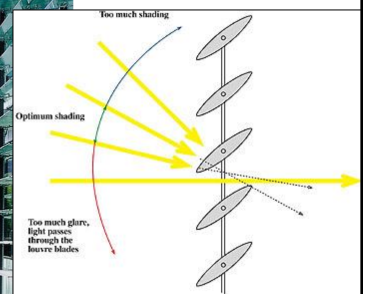
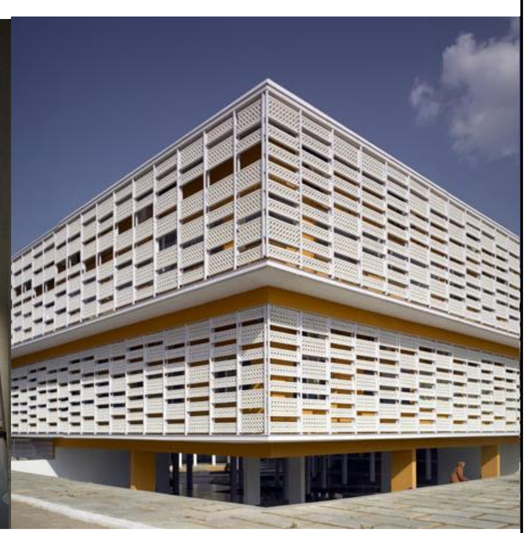
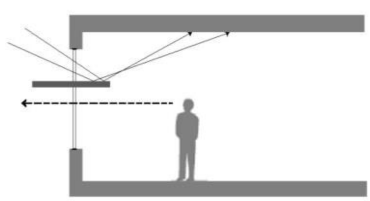
Building Integrated Photo Voltaics (BIPV)

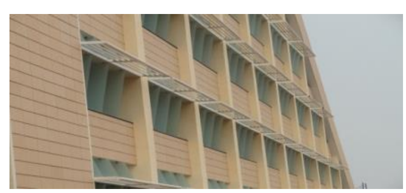




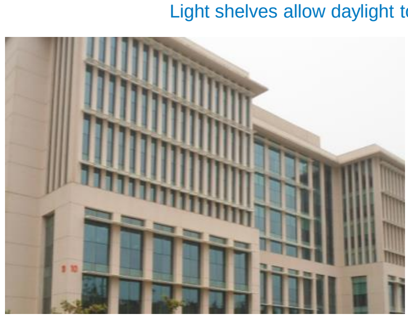
IRRAD complex Source: Ashok Lall Architects

Efficient façade design





Light shelves allow daylight to penetrate deeper into the buildings



Mysore SDB 5 building with above strategies

Bright day light without glare

Source: Infosys

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Efficient building envelope

SDB-2 & 3, Infosys Hyderabad campus

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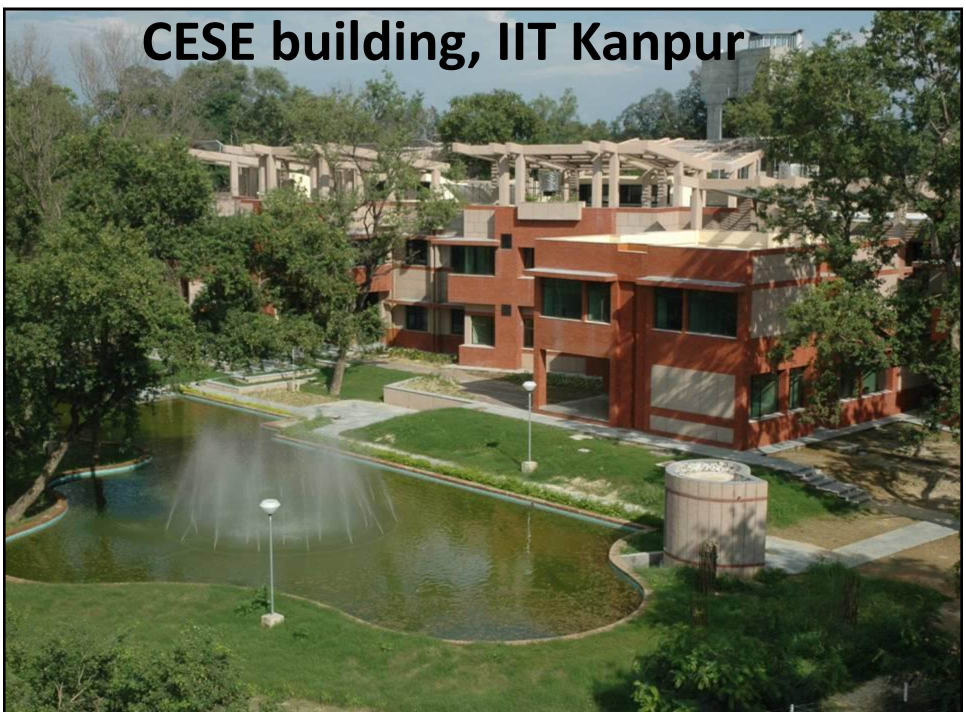
CESE building, IIT Kanpur



CESE building, IIT Kanpur

Suzlon OneEarth, Pune

GRIHA 5 star

EPI (final achieved) = 33 kWh/sqm/annum

VVIP Circuit House, Pune

General Information

Site Area: Approx 9584.24m^2

Built up Area: 4886.90 m^2

Air-conditioned Area: 2629.93 m^2

Non Air- conditioned Area: 2256.97 m^2

Energy Performance Index (EPI): 89.16 KWh/ m^2/year

Renewable Energy: Rated capacity of solar PV installed on site is 22 KW

GRIHA provisional rating: 5 Stars

Year of completion: 2014 - 15

More than 80% of the regularly occupied spaces receive optimum daylight. The building is optimally oriented and façade is designed such that the heat gain is minimized and daylight is maximized.

Govardhan Ecovillage , Thane

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General Information

Location: Galtare, Wada, Thane, Maharashtra - 421303

Site Area: 70 acres

Built up Area: 2400.65 m2

Non Air- conditioned Area: 2400.65 m2

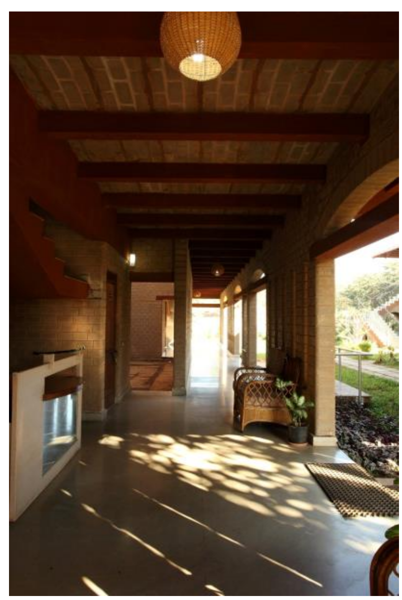
Energy Consumption Reduction: 57% reduction compared to GRIHA benchmark

EPI: 42 KWh/ m2/year

Renewable Energy: 30KWp

GRIHA provisional rating: 5 Stars

Year of completion: …2012…



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- Optimum window openings
- Light floor for light diffusion
- Soft landscape outside giving no reflected glare
- Shaded walls and openings

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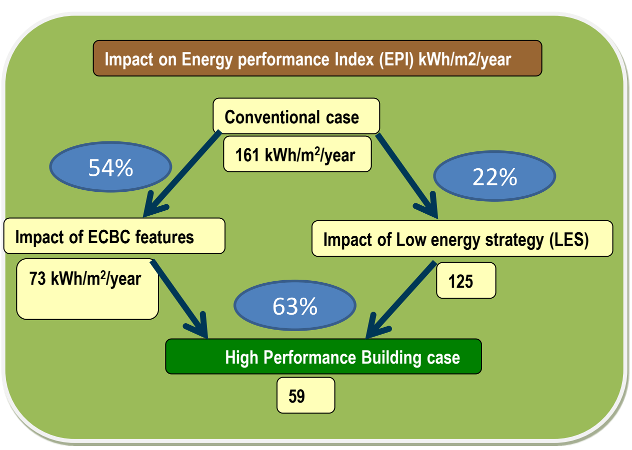
High Performance Commercial Buildings in India Studies under APP



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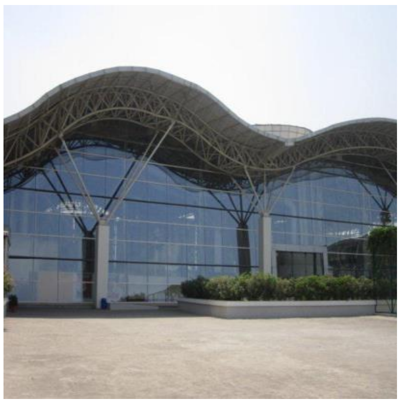
Façade retrofits

- New buildings absorb 5 times less heat compared to existing buildings
- Opportunity to reduce heat gain in existing buildings through glazing, shading and insulation



Source: Infosys

Thank You

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